Approval of Start of Construction (CD-3b)
for the
Main Injector Experiment v-A (MINERvA) Project
at the
Fermi National Accelerator Laboratory
Office of High Energy Physics
Office of Science

A Purpose

This document is submitted to the Office of Science Energy Systems Acquisition Advisory Board (ESAAB)-equivalent for approval of Critical Decision 3b (CD-3b), Start of Construction for the Main Injector Experiment v-A (MINERvA) Project at Fermi National Accelerator Laboratory (FNAL). Mission Need, CD-0, was approved on June 23, 2006. Alternative Selection and Cost Range, CD-1, Performance Baseline, CD-2, and Start of Limited Construction, CD-3a were approved on March 30, 2007.

The Acquisition Executive (AE), upon signature of this document, will grant approval of CD-3b. A description of the project and status of the prerequisites necessary for critical decision approval are detailed in this document.

B Project Description

The Neutrinos at the Main Injector (NuMI) beamline at FNAL provides a neutrino beam of extremely high intensity. With the NuMI beam, statistically significant neutrino measurements are feasible with much lighter targets than was previously the case. The goal of the MINERvA experiment is to perform a high-statistics neutrino-nucleus scattering experiment using a fine-grained, fully active scintillator detector. The MINERvA detector will be located in the NuMI beam, directly upstream of the existing Main Injector Neutrino Oscillation Search (MINOS) Near Detector in the Near Detector Hall at FNAL. The MINERvA detector will consist of an active target made of solid scintillator bars, surrounded on all sides by an electromagnetic calorimeter and a hadronic calorimeter. The upstream end of the detector contains nuclear targets of graphite, iron, and lead. The detector is hexagonally shaped and has three stereo views for precise tracking. It will be located as closely as possible to the MINOS Near Detector, which may serve as a muon identifier for MINERvA. The MINERvA Project encompasses the construction and testing of the MINERvA detector. The installation and operation of the detector are excluded from the project to provide the needed flexibility to complete the project to CD-4, Project Completion, independently of scheduling issues associated with NuMI/MINOS and the FNAL accelerator complex.

C Mission Need

The MINERvA Project is the fabrication of a high resolution neutrino detector capable of distinguishing explicit final states in the energy range of 0.5 to 3.0 GeV and measuring their neutrino cross-sections. The project supports the Department of Energy's Science Strategic Goal within the Department's Strategic Plan date September 30, 2003: *To protect our National and economic security by providing world-class scientific research capacity and advancing scientific knowledge*. Specifically, it will support the two Science strategies: *1. Advance the fields of high-energy and nuclear physics, including the understanding of … the lack of symmetry in the universe, the basic constituents of matter…* and *7. Provide the Nation's science community access to world-class research facilities.…*.

The AE, Dr. Robin Staffin, Associate Director of the Office of High Energy Physics (HEP), approved Critical Decision 0, Mission Need, on June 23, 2006.

D Critical Decision 1/2/3a

Critical Decision 1, Approval of Alternative Selection and Cost Range, Critical Decision 2, Approval of the Performance Baseline and Critical Decision 3a, Approval of the Start of Limited Construction, were approved by the AE, Dr. Robin Staffin, Associate Director of the Office of High Energy Physics (HEP), on March 30, 2007.

E Approval Prerequisites

i) Design Sufficiently Mature to Start Procurement – The design status by Work Breakdown Structure (WBS) is included in the table below. The table also includes the date by which the final design is required.

	WBS Element	Design Status	Outstanding issue	Need by Date
1.0	Scintillator Extrusion	100%	None	Dec-07
2.0	WLS Fibers	100%	None	Aug-07
3.0	Scintillator Plane Assembly	98%	Motion Control for On Site QA Station	Dec-07
4.0	Clear Fiber Cables	100%	None	Oct-07
5.0	Photomultiplier Tube (PMT) Boxes	100%	None	Dec-07
6.0	Photomultiplier Tubes	100%	None	Mar-08
7.0	Electronics and DAQ	100%	None	Jan-08
8.0	Frames, Absorbers, and Stand	100%	None	Dec-08
9.0	Module Assembly and Veto Wall	87%	Veto Wall and PMT Lifting Jig	Sept-08

ii) Project Documentation – Required documentation, including the Project Execution Plan and the Acquisition Strategy, for the project had been approved prior to the March 30, 2007 CD-1/2/3a approval. No changes have occurred to the documentation which would require revision.

iii) Independent Project Review – An Independent Project Review (as defined in DOE O 413.3A) was performed by the Office of Project Assessment at the request of the Office of High Energy Physics on August 21, 2007. The review committee judged that the project documentation is sufficiently complete and that the project was ready for CD-3b approval. The table below identifies the review recommendations and the project's responses.

Recommendation	**Project Response**
The project should investigate the possible use of a commercial reflectometer to measure the light reflection from the mirrored end of each fiber.	This has been investigated and it was determined that the increased resources required for the additional R&D and with preparing both ends of each fiber were not justified given the relative cost and high success rate of the current mirroring QC procedure. (a document has been prepared)
Close attention should be paid to longitudinal scans of scintillator fiber assemblies to avoid large, local response variations.	Immediate longitudinal scans of the first planes for the tracking prototype are scheduled for this fall and sparser scans at the factories are planned as part of the factory QA process currently under development. (a document is in preparation)
An internal, in-depth review of the assembly of the Tracking Prototype should be made, and lessons learned, prior to the start of the main detector production. This should not affect the ordering of materials, but could result in improved assembly procedure(s) and a better overall detector.	A combined WBS 3,8,9 review has been entered into the project schedule and the document database and will occur in October 2008 after the tracking prototype is assembled and completed and is to be completed prior to full detector assembly.
Begin the preparation of the PMT purchase order at the earliest possible date.	Preparation began in mid-September when the Fermilab procurement office posted a Federal Business Opportunity Web site with the specifications for the PMT's for a purchase date of 12/2/07.
Management should track carefully the mapper development and performance.	Mapper assembly and commissioning is being handled directly by the Integration Coordinator and by the WBS 9 Level 2 Manager. Mapper progress will be reported at weekly Level 2 Manager meetings.

iv) Hazard Analysis Report – A Hazard Assessment has been written and was updated to included work done at Universities. The Hazard Assessment covers the many phases of the experiment, including:

a. Initial prototyping above ground
b. Detector construction above ground
c. Installation in the underground enclosure
d. Operations underground
e. Decommissioning

Additionally, a Preliminary Safety Assessment Document has been approved by the Fermilab Directorate and the Fermilab ES&H Section, and this will be incorporated into the NuMI Safety Analysis Document prior to the detector being installed underground.

v) Construction Project Safety and Health Plan – The design, assembly, commissioning, operation, and de-commissioning of MINERvA will be performed in compliance with the standards in the Fermilab ES&H Manual. In addition, all related work, including work performed off-site, will be performed in compliance with applicable federal, state, and local regulations. The MINERvA Project is not a construction project and therefore a Construction Project Safety and Health Plan is not required. However, it was deemed useful to outline the interfaces that the project will have with existing laboratory infrastructure. A Construction Management document was written and approved by the Fermilab Directorate and ES&H Section documenting these interfaces.

vi) Quality Assurance Program – A Quality Assurance Plan has been prepared for the project and the plan has been approved by the Federal Project Director.

F Project Baseline

i) Project Scope Baseline – The baseline scope of the Project is the construction and testing of the MINERvA detector to be installed in the MINOS Near Detector Hall at FNAL. The CD-4, Project Closeout, requirements have been established, and are as follows:

Subsystem	Measurement	Commissioning Goal
Detector Modules	Modules Mapped with Radioactive Source	108 loaded frames of the Detector Modules assembled and mapped; and greater than or equal to 86 frames (80%) have greater than or equal to 119 strips per plane sensitive to a radioactive source (93% of strips per plane).
Electronics and DAQ Readout Chain	Module data read out through DAQ system	Read out radioactive source data through the entire MINERvA Electronics and DAQ chain through one module.
Nuclear Targets Complete	Visual inspection	Nuclear Targets of carbon, steel and lead assembled and passed inspection.
PMTs and PMT Boxes	PMTs and PMT Boxes tested in test stands	Greater than or equal to 449 (95% of total deployed) of PMTs and associated bases, boxes, and electronics pass PMT and PMT box testing criteria.
Clear Fiber Cables	Cable Transmission	3784 clear fiber cables (100% of total deployed) produced and tested; and for at least 80% of the cables, 8 of 8 fibers pass quality control test.

ii) Project Funding – The Total Project Cost (TPC) for the project is $16.8M. This consists of $10.7M Total Estimated Cost (TEC), which is all MIE funds, and $6.1M of Other Project Cost (OPC), which is all operating funds. The MINERvA funding table is as follows:

MINERvA Resource Requirements ($ in Thousands)

	FY06	FY07	FY08	FY09	FY10	Total
MIE	0	0	5,400	4,900	400	10,700
OPC	800	4,900	400	0	0	6,100
TPC	800	4,900	5,800	4,900	400	16,800

v) Project Cost and Schedule Baselines – The schedule is described by the project's Critical Decision milestones, which are given below:

Critical Decision Milestones

Milestone Description	Baseline Date
CD-0 Approve Mission Need	June 23, 2006 (actual)
CD-1 Approve Alternative Selection and Cost Range	March, 2007 (actual)
CD-2 Approve Performance Baseline	March, 2007 (actual)
CD-3a Approve Start of Limited Construction	March, 2007 (actual)
CD-3b Approve Start of Full Construction	November, 2007
CD-4 Approve Project Completion	April, 2010

The cost baseline broken down by WBS item is shown below:

MINERvA Project
Critical Decision 3b Project Review

Recommendations:
The undersigned "Do Recommend" (Yes) or "Do Not Recommend" (No) approval of CD-3b for the MINERvA Project at FNAL as noted below.

_____ 11/8/07 Yes X No____
ESAAB Secretariat, Office of Project Assessment Date

_____ 11/08/07 Yes ✓ No____
Representative, Non-Proponent SC Program Office Date

_____ 11/8/07 Yes ✓ No____
Representative, Office of Budget and Planning Date

_____ Yes____ No____
Representative, Environmental, Safety and Health Division Date

_____ 11/8/07 Yes ✓ No____
Representative, Security Management Team Date

_____ Yes____ No____
Representative, Laboratory Infrastructure Division Date

_____ Yes____ No____
Representative, Grants and Contracts Division Date

Approval of CD-3b

_____ 11/8/07
Dennis Kovar, Acquisition Executive Date
Acting Associate Director for High Energy Physics
Office of Science